DEVICE FOR ADJUSTING GUIDE BLADES

The present invention relates to a device for adjusting guide blades according to the definition of the species in Claim 1.

Gas turbines, in particular aircraft engines, are made up of a plurality of modules, for example a fan, a combustion chamber, preferably a plurality of compressors, as well as a plurality of turbines. A plurality of stationary guide blades and a plurality of rotating rotor blades are situated in a turbine, as well as in a compressor of the gas turbine. The guide blades are designed to be fixed with respect to a housing of the gas turbine. The rotor blades are assigned to at least one rotor and rotate with respect to the stationary guide blades and the stationary housing. If the turbine or the compressor has a plurality of stages, then guide blades and rotor blades are alternately positioned in series in the axial direction or direction of flow; several rotor blades or guide blades, which form so-called guide-blade rings or rotor-blade rings, also being situated at an axial position, i.e. along the circumference of the rotor or the housing.

The stationary guide blades of a compressor or a turbine may be designed to be able to move or swivel about an axis. Thus, for example, DE 39 13 102 C1 describes a device for adjusting guide blades, where guide blades of a guide-blade ring are connected to an adjusting ring, outside of a housing of the gas turbine, via adjusting levers, so as to be able to swivel, a first end of the, or each, adjusting lever engaging with the adjusting ring, and a second end of the, or each, adjusting lever, opposite to the first end, engaging with an end of a shaft of the respective guide blade. According to the related art, the guide blades are adjusted by hydraulic means, preferably by hydraulic pistons.

Using this as a starting point, the present invention is based on the problem of providing a novel device for adjusting guide blades.

This problem is solved by further refining the device for adjusting guide blades mentioned at the outset, using the features of the characterizing part of Claim 1. According to the present invention, the adjusting ring is assigned a rotor of a torque motor, a stator of the torque motor concentrically surrounding the rotor of the torque motor. The adjusting ring preferably takes the form of a rotor of the torque motor.

According to an advantageous further refinement of the present invention, the electrical energy needed to operate the torque motor is provided by a generator of the gas turbine, the generator having a stator and a rotor, and the rotor of the generator taking the form of a freewheeling generator turbine, which, driven by a gas stream, rotates relative to the stator of a generator and thus generates electrical energy from the kinetic energy of the gas stream.

The stator of the torque motor and the stator of the generator are preferably supported on a common mount fixture, the stator of the generator concentrically surrounding the stator of the torque motor, the two being made out of an electrical sheet-steel laminate. Accordingly, the stator of the torque motor surrounds the rotor of the torque motor, the stator of the generator surrounds the stator of the torque motor and, therefore, the rotor of the torque motor as well, and the rotor of the generator surrounds the stator of the generator and, therefore, the stator and the rotor of the torque motor as well.

Preferred further developments of the present invention are revealed by the dependent subclaims and the following description. Exemplary embodiments of the present invention are explained in detail in light of the drawing without being limited to it. The figure shows:

Fig. 1 a schematic cross-section of a gas turbine of the present invention, in the region of a high-pressure compressor.

In the following, the present invention is described in detail with reference to Fig. 1.

Fig. 1 shows a cut-away cross-section of a high-pressure compressor 10 of a gas turbine of, namely, an aircraft engine. Thus, Fig. 1 shows a flow channel 11 of high-pressure compressor 10, stationary guide blades 12 and rotating rotor blades 13 being positioned one behind the other in flow channel 11, in the axial direction or in the flow direction of the same. Guide blades 12 mounted at an axial position of high-pressure compressor 10 and distributed about its circumference form guide-blade rings, and rotor blades 13 mounted at an axial position form rotor-blade rings. Only one guide-blade ring made up of guide blades 12 and one rotor-blade ring made up of rotor blades 13 are shown in Fig. 1. Of course, several such guide-blade rings and rotor-blade rings may be alternately positioned in series in the flow direction of high-pressure compressor 11.

Flow channel 11 of the high-pressure compressor is bounded by a housing 14. At a radially externally end, stationary guide blades 12 have a shaft 15, with the aid of which the same penetrate housing 14. An adjusting lever 16 engages with shaft 15 of each adjustable guide blade 12, adjusting lever 16 also being connected to an adjusting ring 17. All adjusting

levers 16 of guide blades 12 of a guide-blade ring are connected to the same adjusting ring 17. Therefore, all guide blades 12 of a guide-blade ring may be adjusted or swiveled in unison by rotating adjusting ring 17.

In accordance with the present invention, adjusting ring 17 is assigned a rotor of a torque motor, adjusting ring 17 preferably taking the form of a rotor of the torque motor. A stator 18 of the torque motor concentrically surrounds the adjusting ring 17 taking the form of a rotor of the torque motor, namely radially from the outside.

The electrical energy required for operating the torque motor is provided by a generator 19 of the gas turbine. Generator 19 of the gas turbine has a rotor 20 and a stator 21, as does the torque motor. Rotor 20 of generator 19 takes the form of a freewheeling generator turbine, which, driven by a gas stream, rotates relative to stator 21 of generator 19 and thus generates electrical energy from the kinetic energy of the gas stream. In this context, rotor 20 of generator 19 is preferably driven by a gas stream of a fan or fan module of the gas turbine, not shown. To this end, generator 19 is positioned downstream from the fan or fan module, a generator module having the generator being detachably connected to the fan module at the downstream end of the fan module. Generator 19, i.e. rotor 20 of generator 19, is preferably driven by a bypass gas stream of the fan or fan module and accordingly generates electrical energy from this bypass gas stream.

Rotor 20 of generator 19, taking the form of a freewheeling generator turbine, has a plurality of rotating blades 22, the inner radial ends of blades 22 being connected to an outer bearing ring 26 of a bearing 27 via a platform 23. The inner radial ends of blades 22, i.e. platform 23, are assigned pole pieces 24. As can be gathered from Fig. 1, rotor 20 of

generator 19, together with pole pieces 24, radially surrounds stator 21 of generator 19 on the outside. Stator 21 includes windings and magnetic circuits, in order to ultimately generate electrical energy from the motion or rotation of rotor 20 of generator 19. At least part of the electrical energy generated in stator 21 of generator 19 is supplied to stator 18 of the torque motor and used there for moving or driving adjusting ring 17 taking the form of a rotor of the torque motor.

As can be deduced from Fig. 1, stator 21 of generator 19 and stator 18 of the torque motor are supported on a common mount fixture 28. In this context, stator 21 of generator 19 concentrically surrounds stator 18 of the torque motor and forms, together with it, a unit. Accordingly, stator 18 of the torque motor surrounds the rotor of the torque motor; stator 21 of generator 19 surrounds stator 18 of the torque motor and, therefore, the rotor of the torque motor as well; rotor 20 of generator 19 surrounds stator 21 of generator 19 and, therefore, stator 18 and the rotor of the torque motor as well. The rotor of the torque motor is adjusting ring 17.

Stator 18 of the torque motor includes, in turn, windings, and adjusting ring 17 is assigned magnetic elements 25. Several such magnetic elements 25 are positioned so as to be distributed over the circumference of adjusting ring 17, the gap between two adjacent magnetic elements 25 being dimensioned such that adjusting lever 16 leading to guide blades 12 may be mounted between the same.

Only one guide-blade ring having adjustable guide blades 12 is shown in Fig. 1. Within the meaning of the present invention, the guide blades of a plurality of guide-blade rings may also be adjusted as described above. In this case, the adjustable guide blades of each guide-blade ring are adjustable via an

adjusting ring, each adjusting ring of each guide-blade ring preferably being assigned a rotor of a torque motor.

A completely new design for adjusting the guide blades on a gas turbine is provided by the present invention. The device of the present invention for adjusting guide blades eliminates the hydraulic pistons required by the related art for moving the adjusting ring. With the aid of the present invention, it is possible to use the electrical energy generated by a generator to electrically adjust the guide blades, while adding only a little weight to the gas turbine. The device of the present invention allows the guide blades to be adjusted in a particularly rapid manner, since conventional electromotive drives having gears are dispensed with.